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THE VELOCITIES OF MIGRATORY BIRDS.

By F. J. Stubbs.

Mr. Gurney's remarks on the flight of migratory birds (Zool. 1913, p. 165) prompts me to offer a word or two on the subject. Since the writing of my paper on "The Use of Wind by Migrating Birds" ('Manchester Memoirs,' vol. 53, no. 15), I have seldom failed to take advantage of any circumstance bearing on the question that offered itself to my notice; direct or controlled experiments on normal birds are almost past hoping for, and the most we can do is to make the best of chance opportunities of field observation. A word of warning is necessary in connection with the statistics of Pigeon-flying; the bird is a *non-migrant*, and its sedentary habit is a factor that leads it to cover long distances. I am well aware that the figures derived from homing races are very valuable, but nevertheless one ought never to forget that the Domestic Pigeon is not by nature a long-distance flier. I was once told by a well-known Lancashire "mapper" (the official who fixes the parallel routes in Pigeon races) that a Starling thrown up with the Pigeons in a race from Worcester reached its home in Lancashire, one hundred miles away, far ahead of the first of its larger rivals. I forget the times, and I can only give the word of my informant.

For a great number of years the study of migration has been inconvenienced by the existence of one or two curious superstitions that maintain their hold in spite of attacks. One in particular is the belief that migrants prefer to travel in the teeth of the wind. I have been unable to learn exactly how and when this view became established. Herr Gätke has been blamed, but I think without cause. Long before the publication of his well-known work the "head wind" theory was commonly mentioned in British writings, and although nobody pretended to have reasoned observations in its support, and all were ignorant of any natural law that would have made it credible, it continued to flourish. Gätke (believing, of course, that birds did regularly migrate head to wind, and anxious to suggest a reason) said that they did so in order "to escape the disagreeable experience of having the wind blowing obliquely through their plumage from behind" ('Heligoland,' &c., p. 27). Many present-day writers on flight and migration have repeated this curious explanation, so comical to the mind of the phycisist; and probably the majority of professed ornithologists, if not going so far as Gätke, still believe that a flying bird falls to earth in a "tail wind."

Few tasks can be more thankless than that of attacking a superstition of science, for it is in human nature that "what did not come in by the door of Reason, will not be driven out of that door." Apparently, the "Head Wind Theory" was not based originally on actual observations; I think, however, that its birth was in a misinterpretation of a single common phenomenon. For example, when a bird crosses the North Sea, under adverse conditions, it comes to earth as soon as it sights land. Now, bird migration is visible, as a rule, only when it ceases to act, and most of our observations are based upon birds that have for some reason or other *ceased to migrate*, either temporarily or permanently. No one would pretend to think that every migrant crossing the North Sea comes to earth the moment it sights land; only the weaklings, or those destined for that particular locality, become visible to the terrestrial observer, and the main bodies pass overhead in their courses to Cornwall, Wales, or Ireland—to name these destinations at random.

A head wind, as I shall soon show, is an adverse condition, and birds encountering it are glad to drop to earth, and in this way come to the knowledge of the observer on the coast. Thus the collector or the wildfowler is led quite properly to view a head wind as the one bringing most migrants, and the next step is to believe that birds actually *prefer* such a wind.

BRITISH MUSEUM

The fact that a head wind *stops* migration, and that they are seeing *retarded* birds, seems to have eluded the understanding of Gätke and others.

The "feather-ruffling" aspect is also based on the misinterpretation of a common observation. Such birds as Lapwings, in rough weather, constantly stand head to wind. If they happen to turn, their feathers are ruffled. A not too robust philosophy has led many people to say that exactly the same thing happens if the bird is flying, and no longer on the ground. The equally absurd if less inexcusable belief that *a flying bird, if it is to maintain its altitude, must move at a greater velocity than the wind if flying in the same direction* is based on the fact that a cyclist, for example, riding at twelve miles an hour in the teeth of a wind of the same velocity, rushes through the air at the speed of twenty-four miles an hour. Riding in the opposite direction, of course, he is in effect in a calm.

A bird must maintain a certain speed to keep itself in the air—let us say twelve miles an hour. The idea is that flying tail to wind (velocity twelve miles per hour) it finds itself in a calm, and "the air ceases to support it; it falls to the ground." The theory is a good example of its kind—unsupported by observations, and directly opposed to four or five well-known natural laws; it is, of course, merely a logical outcome of the superstition of head winds. The actual "facts" have not been observed, but evolved in the mind of the writer, in agreement with his theory. There is no such thing as wind, as we know it, to the flying bird. It is travelling in a medium that happens to be moving bodily over the surface of the earth. The man feels the same medium rushing past him.

The point is: Can a bird fly tail to wind, or head to wind? What observations are available? On many occasions I have seen birds *unable to travel head to wind*, and I have also seen birds *moving at great speed tail to wind.* On March 6th, 1909, a blizzard of unusual severity raged over the greater part of England. I happened to be at that time on the Lincolnshire coast, and, notwithstanding an unparalleled state of bodily discomfort, I contrived to carry out some experiments on the birds. The wind, at the sea-level, was blowing, so far as I could estimate it without instruments, at not less than fifty miles per hour.

Great numbers of birds were sheltering in the hollow ditches, and when I struck one of these the inmates were forced to take wing. A single example will suffice here.

Walking up wind to a ditch, I came upon a small party of Hooded Crows, and on my approach these tried to fly away from me, in the teeth of the blizzard. Flying at what was obviously their full speed, they made no headway whatever, and, indeed, even moved very slowly towards me; had I been free from the wind myself, I could easily have touched one of them with my walking-stick, and thus they hung for a second or so in the air before me. Finding their efforts useless in that direction, the birds promptly turned tail, and swept past me down wind. I turned also, and saw them rise high in the air to clear a group of tall trees a quarter of a mile inland.

Let us assume for the moment that the wind was exactly fifty miles per hour, or, as an alternative, that the speed of the Crow is fifty miles per hour. Flying head to wind, as we have seen, their velocity *in relation to the earth* was $50-50=0$ miles per hour, but in the opposite direction it must have been $50+50=100$ miles per hour over the surface of the earth. Since then I have made many similar observations (but never under such terrible conditions!). No longer ago than May 12th last, sitting in the shelter of a rock at the summit of one of the Peak hills, I saw a Titlark flying head to wind, and moving tail foremost past my shelter at an estimated speed of two miles an hour. Assuming that its usual velocity was 30, the wind must have been 32, and when the bird turned (as it did do) its net speed between points on the earth's surface was $30+32=62$ miles per hour. If we use these figures in conjunction with the "Head Wind Theory" of migration, we shall see that such a bird as a Titlark could not cross the North Sea in less than 150 hours, unless the so-called "favouring" wind kept below 28 miles per hour; but if we drop this theory and admit that a bird actually can fly tail to wind, we shall see that with a 30-mile breeze a Titlark could cross the North Sea in five hours. I cannot say that I quite follow Mr. W. Eagle Clarke in his interesting and epochal work, 'Studies in Bird Migration.' As I understand his remarks, he does not now insist on the acceptance of his "head wind" views described in the Report of the British Association (Liverpool, 1896, pp. 451–477), but expresses a belief that winds have little or no influence on migration (i. p. 178). Possibly some day we shall have an account of the observations and the deductions on which this remarkable opinion is based, but in the absence of these details, I am inclined to urge that every single mile in the velocity of the wind has its influence on the speed and the routes of the migrants that happen to be on the wing at that time. It is perhaps my own obtuseness, but I confess I do not quite follow Mr. Clarke's "matured opinions." I was greatly disappointed to find this important matter of winds almost entirely overlooked in the book, and the question left much as it was twenty years ago, with the exception of an opinion—that winds have no influence—which is unfortunately in direct disagreement with the results of the experiments now to be described. I may be pardoned for pointing out that these results support the conclusions given in my paper, which was published in the spring of 1909, before the genesis of the successful aeroplane.

It was my good fortune to be present in the House of Commons on March 19th last, when the Secretary of State for War delivered his notable speech on Aviation in the Army. This speech was widely published, but no part of it reached the ornithological literature of the day, although certainly it came within the province of the student of birds. Two items worth notice are accounts of experiments that can be made most useful in the present discussion. One day, when the wind was blowing at 57 miles per hour, an officer rose in his aeroplane in the teeth of the wind, and after 16 minutes' flying had covered a distance of no more than 400 yards, at a net velocity in relation to the earth of less than a mile an hour. On another occasion, with "a wind of great violence," a second officer flew to and from a point 21 miles away. "Head to wind," the journey occupied 1¼ hours, at a velocity of 17 miles per hour; and "tail to wind," the distance was covered in 3 minutes 56 seconds, a velocity of 115 miles per hour. Is any supporter of the "Head Wind" theory ready to claim one law for the bird and another for the machine? If not, the "Head Wind" theory must be abandoned.

In my "Wind and Migratory Birds" paper, I discuss the influence of cyclones on migration. It occurred to me that this matter might be worked out theoretically, and I arranged a sort of time-table, giving the speeds of a stream of birds an hour apart, crossing a series of concentric eddies moving at known velocities in a given direction. The actual courses, as worked out for me by Mr. H. G. Taylor, M.Sc., A.M.I.C.E., prove conclusively that a "migration route," either for a species or for a general tide of birds, is a physical impossibility. Mr. T. A. Coward, in his tiny yet most valuable book, 'The Migration of Birds,' has figured a route modified from one of Mr. Taylor's charts, and I hope soon to see the publication of a set of these significant diagrams, with the data on which they are based.

Perhaps those who do not readily understand how a flying bird *cannot possibly* have its feathers ruffled by the wind—and I admit that the reasoning is not so simple as some would have us believe—may be contented with the account of a simple experiment that can be repeated as often as desired. In places where Gulls are in the habit of being fed it is easy to persuade any individual bird to move in a circle. Choose a bird and toss it a fragment of fish; then, as the same individual flies past again throw it another; in a short time it will make its circles as small as possible, in order to lessen the intervals between the morsels of food (in the Black-headed Gull the minimum circle is about thirty to thirty-five feet in still weather). On a windy day watch the plumage carefully, especially during that part of its course when the bird is tail to wind—*there will be no ruffling* in any way. Observe, however, that as the Gull is about to alight, when flight has ceased and the force of gravity acts as a sort of connection with the earth, the feathers *are* often ruffled, although the bird is in the air.

It should now be clear that birds cannot cover long distances against a wind; that they can, and regularly do, fly with the wind, and this without any ruffling of plumage, and without loss of lifting power; and I would go further, and express my belief that the migrations of birds are aided to a very great extent by the movements of the atmosphere. Every field ornithologist must be familiar with the intelligent manner in which birds habitually make use of local currents or eddies of air or water, either in play or when about their more serious affairs: a Swan using its wings as sails; Gulls utilizing the upward current above a cliff to save wing power; or—a comical instance—Sparrows sheltering from wind or rain in the narrow, dry, vertical area a yard or so from the corner of an ivied lee wall, while intellectual mankind below is getting wet through!

If we examine a diagram of the atmospheric currents of the earth, we see that there are regular tides between the Equator and the Poles. A migrant must of necessity either fly *with* or *against* these currents—we can ignore "beam winds" for the present—on its annual journeys. To travel head to wind is, as we see, wasteful and even dangerous, and from what we know of the habits of birds in relation to winds and short flights, we are led to expect that they are intelligent enough to take advantage of air currents for long flights. A critic of my earlier paper was led to view the migrant as "boarding" the rim of a cyclone as one might board a moving roadway, and dropping off when that part of the atmosphere came above its destination, or as near that spot as possible. This was rather a flippant way of interpreting my views, but after all I cannot see any very great objection to it, except that certain people are justly suspicious of scientific views that are not couched in some form of scientific argot.

Migrants certainly possess the sense of direction to a high degree, and this aspect of the study is a most important one. I would draw attention to an unusually interesting paper by Dr. C. Viguier on "Le Sens de l'Orientation et ses organes chez les Animaux et chez l'Homme," in the 'Revue Philosophique' of 1882 (xiv. pp. 1–36). So far as I know, this piece of work, even to-day and to a greater extent thirty years ago of prime interest to the ornithologist, has not been even mentioned in any British book or paper. Yet, on the other hand, Gätke's work received a flattering welcome, although his book contained a number of palpable errors. Many of these were combated by Mr. F. B. Whitlock and others, but the personality of the man and the ornithological richness of his island have ensured him a wide circle of sympathetic readers for his fascinating book.*

The experiments made with flying machines demonstrate that winds directly influence the speed of aeroplanes moving in them—a head wind retards, a tail wind accelerates, beam winds carry the machines out of their courses. These results agree in every way with all the observations I have made on wild birds, and are quite in keeping with all known natural laws. On the other hand, they are in violent opposition to the popular "Head Wind" theory of modern ornithologists, with its weird by-products of "feather-ruffling," and so forth: and I hold that this latter theory was erroneous in the first place, and has never during its existence received any support from checked and tested observations.

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* All cautious students of Gätke's book should read also Whitlock's 'Migration of Birds; a Consideration of Herr Gätke's Views' (1897, 8vo).

Perhaps I might offer the following as a help to those who do not care to treat the problem theoretically. One day I saw, during a "balloon race," two balloons at an altitude of 2000 ft., travelling tandem, about half a mile apart. There was a good wind, and the vessels were drifting across the surface of the earth at about 60 miles per hour. The aeronauts, of course, were unconscious of this wind; the balloons, with their ropes and hanging flags, were as rigid as though carved from metal; and there was the usual strange experience of standing in a strong wind and seeing the yellow mist of the falling ballast in a perfectly vertical column. The air around and between these two balloons was certainly as calm as that of a vault. Now, let us try and imagine a strong pigeon being released from the *second* balloon, and flying in a straight line to the *first*, with a velocity of 60 miles an hour. In 30 seconds it would have covered the journey; but, at the same time, the two balloons, and the medium supporting them, would have travelled over half a mile of the earth's surface. The speed of the bird, to the terrestrial observer, would be therefore one mile in 30 seconds, or 120 miles per hour. If we now imagine the bird returning to the second balloon, it would complete its half mile of vigorous flight and still remain *precisely over the same spot on the earth.* According to the "head wind" ornithologists, it ought to be moving at an enhanced speed across the earth under these circumstances. Let us hope the theory has a champion ready to come forward with calculation or observation explaining just how it is achieved.

STRAY NOTES ON THE BIRDS OF TRINIDAD AND TOBAGO, BRITISH WEST INDIES.

By Collingwood Ingram.

Haleland Park, near Port of Spain, Trinidad, December 20th, 1912.—The Yellow-breasted "Qu'est-ce-qu'il dit" (*Pitangus sulphuratus trinitatus*) is certain to be the first bird to obtrude itself upon the visitor's notice. Not only on account of its abundance —for it is even common within the precincts of the city--but because it has a habit of constantly screeching out its name in a harsh, unmusical voice. Were it not for these frantic vociferations, this Tyrant would be an attractive bird, for it has many quaint ways that point to its being endowed with more than the ordinary run of avine intelligence. At this season it is usually to be seen in closely consorting pairs, and I have no doubt that fear of separation accounts for much of this disagreeable noisiness.

When I was in Port of Spain seven years ago, the "Johnny Crow"—a black and unsightly Vulture (*Catharista atrata*)—was common everywhere, and was so familiar that it is hardly an exaggeration to say that one almost stumbled over the birds in the streets of the town. Since then they have fallen on evil days. The Trinidadians do not question their utility as scavengers, but charge them with carrying their unsavoury viands on to the roofs of the houses, whence morsels are occasionally dropped into the fresh-water cisterns. This is hardly in accordance with their ideas of hygiene, so the edict went forth that the birds should be destroyed. "Johnny Crow" has consequently been obliged to withdraw from the town, but he may yet be seen in goodly numbers round the slaughter-house and on the "dumping" ground beyond the harbour. In the township of Le Brea, however, he is as tame as ever, and still shares the garbage of the streets with the gaunt pigs and lean pariah dogs, scarcely deigning to move out of the way of the passing negro.

December 23rd.—For several days I have been speculating as to the owner of a peculiarly sad voice that I have heard calling from the wooded hillsides. It is a very striking sound—a clear, mellow pipe, followed, after a distinct pause, by a single, or sometimes a dual, note in a much lower key. To attempt to trace its author amidst the tropical vegetation seemed a well-nigh hopeless task, as, indeed, it would have been had I not bethought myself of the simple device of calling the bird to *me*. I found it was not difficult to give a plausible imitation of the whistle. Keeping quite still—oblivious of the mosquitoes and the vicious little sandflies!—I repeatedly answered the call, and patiently awaited developments. Very soon the fluty notes of the stranger could be heard approaching nearer and still nearer, until the sound became unbelievably close—in fact, in the very bush that protected me. I could even hear the gentle rustle of a dried leaf as the newcomer stirred, almost under my feet, and the next instant a small brown bird strode, with a jerky flick of its uplifted tail, into full view, not an arm's length from where I was crouching. In every detail it was a miniature Rail—it had the same stooping, hesitating gait, the same spasmodic flick of the tail; yet I knew it to be a very different species—one of the Ant-Thrushes; in fact, the "Coq-bois" (*Formicarius analis saturatus*).

As though in duty bound, and apparently without a semblance of pleasure, the bird frequently stayed its peregrinations to raise its head and utter this loud, joyless challenge. It would then proceed on its way, taking a few long strides over the ground, only to stop again either to search among the dried leaves for its insect food, or to reiterate its doleful notes. A strictly terrestrial species, the "Coq-bois" appears to be one of the few birds that habitually affect the gloomy under-world of the forest, the majority preferring the well-lighted upper branches of the bushes and trees.

Another member of the same family (*Formicariidæ*), likewise possessing a characteristic voice, is the "Pintade" (*Thamnophilus doliatus*). This is a curious looking fellow with a black-and-white barred livery, while his wife, usually in close attendance, is very differently dressed in tawny brown. He is not uncommon, and is found inhabiting the dense thickets of wild vines and other growths, whence he keeps in touch with his mate by a rattling chortle—a curiously "thick" sound uttered in a quickly descending scale.

Trinidad, December 24th.—This morning I was astir long before the break of day, joining a party of Creole deer-hunters on an excursion to a neighbouring valley. When I left my house at three the full moon was just sinking behind the hills to the northwards, and the light from it seemed to plate the burnished foliage of the Tropics with an extraordinary wealth of silver. The air was delightfully fresh and charged with the pungent smell of growing things. A heavy dew lay upon everything, soaking our clothes as we forced our way along the overgrown pathways. The noisy din of insects—so aggressively loud when one retires to bed—had almost ceased, but one still heard the occasional cry of some unknown night bird, and the more familiar muffled "poop-poop-poop" of the "Petite Chouette" (*Glaucidium phalænoides*). This pigmy Owl, scarce larger than a Sparrow, is very common in Trinidad, where I have both seen and heard it in broad daylight. It is exceedingly sprightly in all its movements, and has a peculiar habit of violently jerking its tail. Its note, repeated ten or twelve times in succession, although soft, is nevertheless loud and resonant, and on account of its monotony soon becomes wearisome.

With the first paling of dawn a babel of bird voices fell upon my ear, and this speedily increased in volume until the forest glades were filled with a clamour of strange and unfamiliar sounds. A naturalist fresh from northern latitudes is sure to be impressed by the infinite variety of these notes. It is not so much that each bird possesses a large vocabulary (the reverse is probably the case), but that the island is remarkably rich in species, most of these being represented by a comparatively even (and often small) number of individuals. Compared with European birds, the notes of these tropical species are generally harsh and squeally, a sustained musical song being almost unknown in this country.

One of the first birds to make itself heard was the "Caille," a species of Tinamou (*Crypturus soui*).* It produces a shrill, sibilant sound—a rather mournful, high-pitched note, suggesting to the mind the quivering, silvery neigh of some fabulous creature rather than the cry of a bird. With ventriloquistic power, a few individuals repeatedly answering one another will scatter

* *Crypturus pileatus*, auct.

this sound over a valley in a truly bewildering manner, giving one the impression that the bird is really commoner than is actually the case. Pre-eminently a ground bird, the "Caille" will only take to its wings under compunction. Once forced to fly, however, it rises with a surprising bluster and whirr of wings, and I can vouch for it, that as it swings sharply through the cocoa trees it is an amazingly difficult bird to hit!

Then one distinguished the plaintive cat-like "me-er" of the "Grive" (*Turdus gymnophthalma*), and again, from down among the black shadows of a deep dell, the bold notes of the "Coucou" (*Thamnophilus major*). Suddenly a great chattering sound attracted my attention, and on looking up I espied a squealing bevy of Parrakeets (*Urochroma cingulata*) flying hurriedly southwards. This flock, or one similar to it, passes over Haleland Park regularly every morning and evening on their way to and from their feeding grounds. The birds always seem to travel high, and in a fairly compact body of twenty or thirty individuals, and all the time they maintain a constant outcry of chattering notes.

These are a few of the avine voices I have already learnt to distinguish, but as the sun rises, and the "High Woods"* fill with the sound of awakening bird-life, I realize that the vast majority still remain unknown to me, but if I have time I shall hope to make their acquaintance later on!

Trinidad, December 27th.—Stirred by the many and wondrous tales of the Tarpon—or "Grand Ecaille," as they call him here—this afternoon I went out trolling in the Gulf of Paria. Beyond a sudden and violent tug, for all I knew the waters might have been fishless! But the outing was nevertheless entertaining, and I saw much to keep me interested. Overhead there were always a number of Frigate or Man-o'-War Birds (*Fregata aquila*) to be seen. At one time I counted as many as seventeen together, soaring in wide circles above the Five Islands. The majority of them were young birds, as was denoted by their white throats, but I also observed a fair sprinkling of adults. If, at first, one is inclined to admire the clear-cut outline of this strange species, one soon appreciates that in reality it is a somewhat unwieldy creature, for, like a yacht under too heavy an expanse of canvas, it often seems to find a difficulty in manœuvring neatly; at any rate, it does not appear to fly with that ease and grace one is accustomed to associate with a really well-proportioned bird. I noticed one drop out of the skies to gather something from the sea; bending sharply its immensely long wings, it fell in a kind of spiral, turning round several times in the descent. Several immature brown-plumaged Boobies (*Sula leucogastra*) were continually plying to and fro across the Gulf. The other day I heard of one seizing a large spoon-bait that was being used for Tarpon, but the bird dropped it when only a few feet from the water, and was uninjured by the hooks.

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* "High Woods" is the local term for the virgin forest.

The stately Pelican (*Pelecanus fuscus*) was also present in considerable numbers. In apparent contradiction to their habits and structure, they are very fond of sitting with stolid mien on the frailest of branches, usually overhanging some beetling cliff. It is curious how, for no ostensible reason, they use one or two trees only for this purpose, and never favour any others along the same portion of the coast.

I noticed several "Rainbats," as the little Swifts (*Chætura cinierventris lawrencei*) are called, flying in and out of a low-mouthed cave. Hoping to find signs of their nests, I landed and waded in, but the vault of the cavern was lost in obscurity, and I could make nothing of them. As I entered three or four birds dashed out, brushing close past my face. In the cool hours of the mornings and evenings flocks of these Swifts, together with the commoner *C. spinicauda*, may be noted hawking for insects above some of the mountain valleys, but they disappear entirely during the heat of the day.

The dusky Hawk (*Urabitinga anthracina*) appears to be not uncommon along the cliffs, and is often seen resting on a prominent branch in the shade. He is a fine-looking bird, with a bright yellow bill and a well-marked white band across the middle of the tail, which is very conspicuous during flight. I fancy he must prey on the Iguana, for many of these reptiles may be seen basking on the uppermost branches of the cliff-growing trees. Some largish Martins (*Progne chalybea*) were also benefiting by the cool air of these precipices, but one sees many more under the high bluffs by Macaripe Bay, where I believe they nest in the crevices of the rocks. They likewise settle on the clinging vegetation, and should a Black Hawk trespass on their domain they make repeated but, of course, wholly ineffective onslaughts upon the intruder.

An Osprey (*P. haliaëtus carolinensis*) was also noticed skirting the coast, but he was evidently a wanderer, for he soon disappeared towards the shadowy outline of the Venezuelan mountains.

Tobago, January 2nd, 1913.—A long, sweeping beach fringed with a belt of coconut palms, and ending in a small headland supporting a few dilapidated shanties, is all that now remains of Plymouth and its harbour—the former capital of the once prosperous sugar island of Tobago. But when we steamed into Courland Bay about two o'clock this afternoon, I had no eyes for these details, being fascinated by the vast numbers of Pelicans that were to be seen—a seemingly interminable line of birds, almost all of whom were busily engaged in fishing. As a matter of fact, they were strung out for a mile or more along the coast, keeping about thirty or forty feet from the shore, where, it is to be presumed, the shoals of fish were cruising. A few were resting—riding buoyantly on the water—but the majority were on the wing, either flying back to the far end of the bay, or fishing systematically up-wind in a kind of endless procession. As they proceeded leisurely against the soft "trade" breeze, the birds could be seen peering downwards, carefully scrutinizing the water. Suddenly one—often two or three together—would close its wings, turn over, and hurl itself, Gannet-fashion, at its prey. Judging by the frequency of these plunges, the bay must have been literally teeming with fish, for sometimes as many as ten or a dozen splashes could be seen instantaneously, and within quite a small compass. All this, of course, was very interesting, but the remarkable feature of the whole scene was the manner in which some Gulls (*Larus atricilla*) were worrying and robbing the complacent Pelicans of their booty. At points where these were diving oftenest, the Gulls could be noted swimming idly about in twos and threes, awaiting their opportunity. It was evident from the way they always seemed to anticipate the splash that they were watching the movements of the larger birds very closely. Thus before the Pelican had time to come to the surface the Gulls had almost invariably reached the spot, and were already hovering overhead.

Three or four would usually waylay the one bird. Dropping with noisy cries on to the water these would surround their victim, and impudently try and snatch the newly caught fish from its huge bill, which, however, the Pelican wisely kept three parts submerged until the prize was successfully swallowed. On many occasions I noticed that the Gulls actually *settled on the Pelican's back*, from which coign of vantage they could easily reach the tucked-in bill by stretching their heads out and past the other bird's neck. In this way the wretched Pelican would be completely encircled by its tormentors, and the slightest "slip" no doubt meant the loss of its meal. But although I watched this amusing performance repeated scores of times, I cannot honestly say that these avine pickpockets (or would pick-*pouches* be a more appropriate term ?) appeared to be often successful. On the other hand, numbers of Gulls were sitting on the beach, preening their feathers with all the self-satisfied airs of well-fed birds, and there is no doubt in my mind that these, at any rate, had succeeded in stealing a meal.

At this season Gulls appear to be rare round the coasts of Trinidad and Tobago, and beyond a few individuals seen in the Gulf of Paria, the above are the only birds I have yet observed. This is not surprising when one remembers the volcanic origin of the Antilles and the almost tideless waters that surround them. This dearth of suitable feeding grounds is no doubt responsible for the evolution of this piratical habit, though it must be confessed it does not appear to be confined to the *Larus atricilla* visiting the West Indies, for Lord Warwick tells me he has seen them behave in precisely the same manner off Charlotte Harbour, Florida. I have observed a somewhat analogous habit among our own Black-headed Gulls (*L. ridibundus*) in East Scotland. These Gulls, somewhat closely allied to the American species, will often associate with the autumn and winter flocks of Green Plover, with the sole idea of allowing these birds to cater for them. Segregated individuals may be seen standing here and there in the midst of these flocks, waiting patiently until the nearest Plover discovers a worm. This is the Gull's opportunity : he promptly falls upon the rightful owner, and, if lucky, succeeds in driving it away before it has time to devour the wriggling and reluctant annelid.

SOME PHENOMENA OF SPECIES HYBRIDIZATION AMONG PHEASANTS.

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Lecturer on Biology at the London Hospital Medical College, University of London, and at the London School of Medicine for Women, University of London.

A summary of certain results obtained by crossing Silver and Swinhoe Pheasants may be of interest as suggesting further lines of research.

An examination of the skins of hybrids obtained by crossing the two species (*Euplocamus nycthemerus* × *E. swinhoii*) shows that the analysis of the results is extremely difficult, and the interpretation of the features of the hybrid plumage is not without possible pitfalls. A pattern may be exhibited in the hybrids which looks like a somewhat similar pattern in one or other of the two sexes of the parent species. But whether it represents the specific pattern, or is a hybrid character simulating it, or whether it is a sort of dislocated mosaic with some of the unit-characters of the pattern of one sex of one parental species dominant, while other features of the pattern are dominant unit-characters from the other sex of the same species, or from either of the two sexes of the other parental species, is a problem which will require answering for each special feature, by continued experiment. It follows from considerations of this kind that unless the alternative feather patterns and colours with which the investigator is concerned are very strongly marked and divergent, and each represents a single unit-character, or a combination of unit-characters gametically coupled together, great caution is necessary in making definite or positive statements even of the most seemingly apparent results. So that any conclusions which I may have reached, by an examination of these skins of Pheasant hybrids, should be regarded merely as tentative and provisional, and of value only as indicating the nature of the further problems which these preliminary experiments in hybridization have opened out. They will serve to suggest the lines along which further research may be most advantageously continued.

In making the examination of the skins, I confined my attention to three restricted areas of the plumage of the male, leaving the female plumage for subsequent examination. These areas are: (1) The Interscapular Feathers; (2) The Primaries and Secondaries of the Wings; (3) The two Central Rectrices (one right, one left) of the tail.

The chief effects of the various crosses appear to be as follows:—

(1) THE INTERSCAPULAR PLUMAGE.—The first hybrid generation derived from Silver ♀ × Swinhoe ♂ does not give uniform results. I purpose dealing with the interesting details of the polymorphism of the F_1 generation in a subsequent and detailed paper. But one of the most interesting features of this generation is that it appears to manifest a translocation of a plumage character not only from the female sex of one of the parental species to the opposite sex of the hybrid, but from one body region of the female of the species to another body region of the opposite sex of the hybrid. The transmission of the female plumage of one region to the same region in the male of the same race or sub-breed of the same species is a well-known phenomenon. But as far as I know, the result I have just described is new. It is, however, necessary to say that the hybrid character is not *identical* with the species character with which it is compared, and that there is an alternative interpretation; but I am afraid I have not space to enter here into details. The features of this generation also suggest that not only does the male of a species transmit some of the secondary sexual characters of the female of his species, but that the female of a species may transmit those of the male.*

The second hybrid generation (F_1 hybrid ♂ × Silver species ♀) is not uniform. The same sort of translocation as that described in F_1 also appears in this generation. There is also a reduction in the number of pencillings characteristic of the parental species (*E. nycthemerus*, ♂).

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* In this particular case the male of one parental species was concerned, while the female was of the other parental species.

The F_2 generation (F_1 *inter se*) reproduces some F_1 hybrid features, together with clear evidence of segregation of unit-characters. This, however, cannot be discussed in the absence of a detailed statement of results.

(2) THE CENTRAL RECTRICES.—With regard to the two central rectrices of the hybrids, the first hybrid generation and second hybrid generation (F_1 *inter se*) are both polymorphic, and in both generations the most interesting results can be expressed by saying that three transpositions of colour or pattern, or both, have occurred :—

(*a*) From the hen of one species to the cock of the hybrids.
(*b*) From the lateral rectrices of the same species to the central rectrices of the hybrids.
(*c*) The orientation of pattern has been reversed in the course of this transposition, and there has also been a mutual reversal of adjacent colour areas.

(3) THE PRIMARIES AND SECONDARIES.—In the F_1 generation polymorphism is shown, and there is some indication that one of the colours characteristic of the Swinhoe hen has been transposed to the opposite sex in the hybrid. In the F_2 generation (F_1 *inter se*) the chief feature is the manifestation of a complete segregation of the Swinhoe cock character in one of the birds. In another bird a new character not seen in F_1 appears. In a sense it represents a somatic mosaic of the modified pattern of both parental cock species. The other members re-manifest the hybrid polymorphism shown in the F_1 generation.

For the examination of the skins upon which these results are based, I am indebted to the kindness of Mrs. Haig Thomas, who in 1907, at my suggestion, commenced the breeding experiments which are here described, as well as others which yet remain to be dealt with. The object I had in view in suggesting these experiments was to ascertain how far Mendelian principles held true, if true at all, in the transmission of characters among the hybrid descendants of crossed species, as distinct from those of varieties.. I may add that there is evidence of Mendelian segregation, but its nature is such that the fuller discussion of it can only profitably be undertaken when the paper with the details of results is published.

NOTES FROM THE MILLPORT MARINE BIOLOGICAL STATION.

By Richard Elmhirst, F.L.S.

In 'Materials for the Study of Variation' (1894), Professor Bateson has brought together many instances of variations or abnormalities of Echinoderms. Since the publication of the above, numerous other instances have occurred, and at the Millport Station we have specimens as follows :—

Meristic Variation in Asteroids.

Astropecten irregularis.—One specimen with the third ray divided.

Porania pulvillus.—Two specimens, both symmetrical, with only four rays. One of these (fig. 2) was obtained in June, 1912, and lived in captivity for nine months.

Stichaster rosea.—One specimen with the third ray divided almost from the disc.

Cribella oculata.—One specimen with the fourth ray divided (Robertson collection).

Solaster papposus.—One specimen with the eleventh ray (out of thirteen) divided, and another (fig. 3) with the fourth and seventh rays (out of thirteen) divided. Number of rays varies from ten to fifteen.

Solaster endeca.—One specimen with only six rays (fig. 4) (Robertson collection). Number of rays is usually eight to thirteen.

Asterias rubens.—One specimen (unfortunately lost) with six rays, and another with seven rays (fig. 1).

Asterias glacialis.—One specimen with six and another with seven rays (Robertson collection). A third had a small arm at right angles to a ray, as in the *Cribella oculata* mentioned by Bateson, *loc. cit.* p. 440. This specimen has been handed over to Dr. J. F. Gemmill for further investigation.

OPHIUROIDS.

Ophiocoma nigra.—Three specimens with six rays each. Such varieties are not uncommon (*vide* Bateson, *loc. cit.* p. 447).

In numbering the rays of Asteroids it is proper to regard the madrepore as being "between radii I and II, the former being on its dextral and the latter on its sinistral side, while the succeeding members of the series, *viz.* III, IV, V, &c., follow on the sinistral side of II." (Gemmill, Proc. Roy. Phys. Soc. Edinb. vol. 18, p. 181, 1911.)

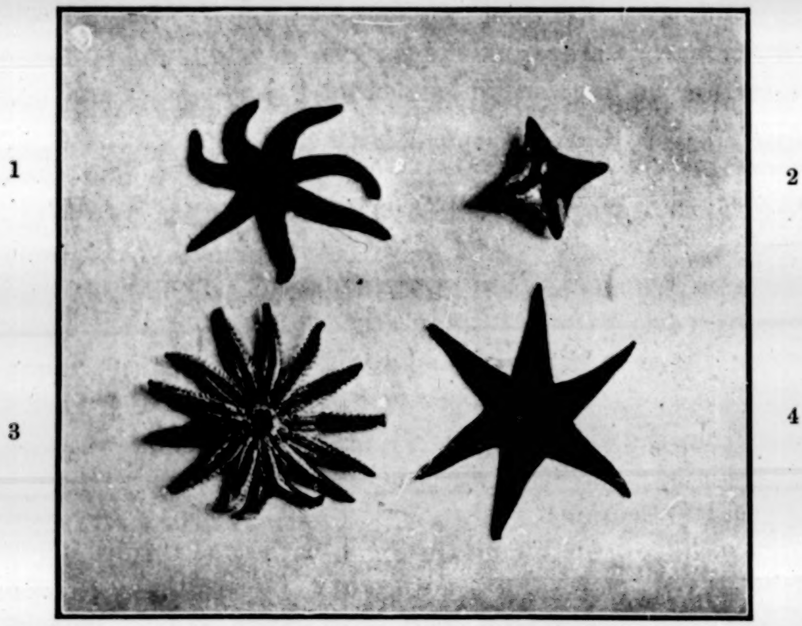


Fig. 1, *A. rubens*; 2, *P. pulvillus*; 3, *S. papposus*; 4, *S. endeca.*

This system has the further advantage of giving the developmental order of sequence of the rays. Following this system, we find that the anus is placed in interradius V/I in five-rayed forms, or V/VI in many-rayed forms. On examining the seven-rayed *A. rubens* and the six-rayed *S. endeca*, the anus was found in both cases in interradius V/VI. This means that the variation in the *Asterias* is towards the *Solaster* type, and the variation in the *Solaster*, by omission of the latest developed rays, is a throwback towards the older Asteroid type.

Deformation in Echinus esculentus.

I have found a specimen in which the third ambulacrum is constricted above the equator of the test or shell, so that the fourteenth pair of radial plates (counting from the aboral end) only bear two large spine tubercles, whereas the fourteenth pair in the other ambulacra have four tubercles. The total width of the third ambulacrum at the constriction is 1 cm., and that of the normal rays at the same level 1·5 cm.; the adjoining interambulacral plates are enlarged, so that in profile the test shows only a very slight flattening in the abnormal ray. At present I cannot hazard an explanation of this interesting variation.

DISTRIBUTION OF BRITISH ANNELIDS.

By the Rev. Hilderic Friend, F.L.S., F.R.M.S.

(Continued from p. 154.)

Scottish Records.

With the exception of one or two records in Dr. Johnston's 'Catalogue of British Worms,' published in 1865, nothing appears to have been done among the Earthworms of Scotland till I took up the subject upwards of twenty years ago. My own researches have been ably supplemented by the labours of Mr. Wm. Evans, F.R.S.E., of Edinburgh, who published, in 1910, an account of the 'Oligochæta (Earthworms and their Allies) of the Forth Area.' The following notes will incorporate all the records which have up till the present been made by myself and others, so far as they have come under my observation, the list being limited as heretofore to the larger forms known as *Lumbricidæ* :—

1. Aberdeen.—Prof. James W. H. Trail sent me a consignment of Earthworms on Nov. 3rd, 1909, collected in his garden in Old Aberdeen. Out of forty-four specimens which were in a fit condition for identification, I found six specimens of (1) *Lumbricus terrestris*, L., six of (2) *L. rubellus*, Hoffm., and eight of (3) *L. castaneus*, Savigny. There were four specimens of (4) *Allolobophora longa*, Ude, ten of (5) *A. caliginosa* forma *turgida*, four of (6) *A. chlorotica*, four of (7) *Dendrobæna subrubicunda*, and two of (8) *Eisenia rosea*. A total of eight species.

2. Ayrshire.—In July, 1892, I received a letter from Mr. M. Young, of Paisley, saying that he proposed visiting the Girvan District, and hoped to send me some gleanings. As they have not yet arrived, I fear the postal authorities have not done their duty! There are no records known to me for Banff.

3. Berwick-on-Tweed is mentioned in Johnston's 'Catalogue,' and four species are recorded, viz.: (1) *Lumbricus terrestris*, (2) *L. festivus*, (3) *L. minor* (= *castaneus* probably), and (4) the Brandling, *Allolobophora* (= *Eisenia*) *fœtida*, Sav.

4. CLACKMANNAN has (1) *A. caliginosa* to its credit, with (2) *Bimastus constrictus*. (See Evans's paper on Forth Area.)

5. DUMFRIES.—To the 'International Journal of Microscopy and Natural Science,' 3rd series (1891), i. 163, *seq.*, I contributed an article on the Earthworms of Scotland, in which, after giving such information as was then available on the general subject, I subjoined an account of the species collected in Dumfries by myself in 1890 and later. "It is curious to observe that the very first worm which I added to the list (*Allolobophora celtica*, Rosa) is exceedingly rare, or, to put it more accurately, has seldom come under observation. I discovered this interesting species in the spring of 1890, when on a flying visit to Langholm and Burnfoot, the home of the Malcolms, in Dumfriesshire. Some two miles north of Langholm, where the road diverges to the left, there is a streamlet of a very unpretentious character. Under the stones on its northern bank I found three specimens of a worm I had not observed previously, which proved on examination to be the one I have mentioned." It now bears the name of (1) *Dendrobæna mammalis*, Sav. Some time after I revisited the spot one Saturday afternoon, failed to find any more specimens, and wandered so far in my search that I lost the last train for Carlisle, and had a most lively experience as a result. In February, 1891, between Annan and the Solway, I found half a dozen specimens of (2) *A. chlorotica* in a brackish pool. Half of them were dead, having apparently been drowned by an exceptionally high tide. The same species was found to the north of the town, while (3) *Lumbricus castaneus*, Sav., was plentiful in the meadows. Near the station the Longworm (4) *A. longa*, Ude, was taken, while (5) *Allurus tetrædrus* was found sparingly near the river a little above Annan. The only other species known in 1891 for this county was (6) *A. turgida*, and about this there is an element of doubt.

6. EDINBURGH.—The list for Edinburgh and district is very large in comparison with that for any other county, thanks to the efforts of Mr. Evans. *Lumbricus festivus* seems as yet to have been found only once on the mainland, but it has once reached me from the Isle of May, so that, if we include this island under Edinburgh, we find all the four species of *Lumbricus* here. These are (1) *L. castaneus*, (2) *L. rubellus*, (3) *L. festivus*,

and (4) *L. terrestris*. The following species of *Allolobophora* and allies are also well authenticated: (5) *A. longa*, Ude, (6) *A. chlorotica*, Sav., (7) *A. caliginosa*, (8) *Eisenia fœtida*, Sav., and (9) *E. rosea*, Sav., (10) *Dendrobæna mammalis*, (11) *D. subrubicunda*, and (12) *D. arborea*; also (13) *Bimastus eiseni*, and (14) *B. constrictus*, with (15) *Allurus tetrædrus*, and (16) *Helodrilus oculatus*, Hoffm. On Feb. 6th, 1905, Mr. Evans sent me a remarkable variety of *A. longa*, with abnormally long tail, segments numbering 240, and of a warm brick-red colour instead of dull sienna. For further details reference may be made to the excellent paper by Mr. Evans, to which allusion has already been made.

7. Fifeshire.—Our knowledge of the annelids of Fife is entirely due to Mr. Evans, who has sent me his gleanings from time to time for identification and record. They were chiefly made in March, 1910, and include one record (*Allurus hercynius*) which is unique. "I was in Fife to-day," writes Mr. Evans on March 19th, "and, seeing ploughs at work in a field near Thornton, I went in and followed them for fully an hour. Worms were plentiful, the most common, perhaps, being (1) *Octolasium cyaneum*, which I was delighted to see. Under stones in an old pasture some other species were found, and a *Dendrobæna* under bark of a rotten stump. . . . I enclose the bulk of the collection for your examination." The species I found were (2) *L. terrestris*, (3) *L. rubellus*, and (4) *L. castaneus*, (5) *Dendrobæna mammalis*, (6) *Bimastus constrictus*, (7) *A. caliginosa*, (8) *E. rosea*, and (9) *Allurus hercynius*, new to Britain, with its common relative (10) *A. tetrædrus*, and (11) *A. chlorotica*. Mr. Evans adds (12) *D. arborea*, and (13) *D. subrubicunda*.

8. Haddington.—April 19th, 1910. Mr. Evans sent me gleanings from Athelstoneford and Tyne, containing eight species, as follows:—(1) *L. terrestris*, (2) *L. rubellus*, (3) *L. castaneus*, (4) *A. longa*, (5) *A. turgida*, (6) *A. chlorotica*, (7) *Eisenia rosea*, and (8) *Allurus tetrædrus*. These are, as will be seen, the most widely distributed of British Earthworms, and are always among the first to be collected. Although Claparède many years ago did good work among the smaller annelids of the Hebrides, I have no records of earthworms therefrom.

9. Inverness.—The Rev. Mr. Macpherson, M.A., sent me

eight species of annelids from Grantown-on-Spey in September, 1898. They were as follows:—(1) *L. terrestris,* (2) *L. rubellus,* (3) *L. castaneus,* (4) *Allolobophora turgida,* (5) *A. chlorotica,* (6) *A. longa,* (7) *Dendrobæna subrubicunda,* and (8) *Allurus tetrædrus.*

10. Kinross.—Mr. Evans records (1) *Allurus tetrædrus,* Sav., and (2) *A. caliginosa.*

11. Lanark.—Although I have at different times had much correspondence with Glasgow and other naturalists, and many promises of help, nothing has ever come of it. The only species recorded is *Allolobophora trapezoides,* which was reported to be damaging a bowling-green in March, 1904.

12. Linlithgow.—A collection made March 12th, 1910, by Mr. Evans contained (1) *L. terrestris,* (2) *L. rubellus,* (3) *L. castaneus,* (4) *A. longa,* (5) *A. caliginosa,* (6) *A. chlorotica,* (7) *D. mammalis,* (8) *Eisenia rosea,* and (9) *D. arborea.* No records are to hand from Moray or Nairn.

13. Peebles.—The list for this county is a good one, considering that it is based on one day's collecting by Mr. Evans in April, 1910. I find exactly a dozen species in my list. There are the three species of *Lumbricus,* (1) *L. rubellus,* (2) *L. castaneus,* and (3) *L. terrestris,* with (4) *A. longa,* (5) *A. caliginosa,* (6) *A. chlorotica,* anomalous form, (7) *Dendrobæna mammalis,* (8) *D. arborea,* (9) *Eisenia fœtida,* (10) *Octolasium cyaneum* (= *studiosum*), (11) *O. profugum* (= *lacteum*), and (12) that rare worm, *Dendrobæna octœdra,* at present unknown elsewhere in Scotland save from Paisley (see Renfrew below), and only occasionally met with in England.

14. Perthshire. — In September, 1890, I received (1) *L. castaneus* from Mr. D. Andrew, who was visiting his brother, Dr. Andrew, at Doune. In June, Mr. S. T. Ellison, of Perth, sent me specimens from the city, including the foregoing, with (2) *A. longa,* one of which was abnormal, (3) *A. turgida,* in vast numbers, (4) *A. chlorotica,* (5) *Eisenia rosea,* and (6) *Allurus tetrædrus.* On September 15th, 1905, Mr. Evans wrote that he had collected "*L. castaneus* (1) and *A. chlorotica* (4) on Perthshire hills at 3250 ft. and 2700 ft. respectively." He has taken (7) *Dendrobæna mammalis* at 2500 ft., and also from the summit of Ben Lawers, 2980 ft., in July, 1906. In April, 1910, Mr. Evans sent me from Balquhidder (8) *L. rubellus,* of an unusual

form, also Nos. 3, 4, 5, and 6, besides (9) *D. arborea*, (10) *D. subrubicunda*, and two species new to Scotland, viz. (11) *Octolasium gracile*, and (12) *Dendrobæna* (= *Eisenia*) *alpina*, which is unique for Great Britain.

15. Renfrew.—In 1892 I had an excellent correspondent in Mr. Morris Young, Curator of the Paisley Museum. On July 3rd Mr. Young informed me that he knew certain worms occurred in the locality, and gave their names. In order that they might be authenticated, he sent me specimens on the 7th, and my list shows no fewer than thirteen species. The four species of *Lumbricus* were all present: (1) *L. terrestris*, (2) *L. rubellus*, (3) *L. festivus*, and (4) *L. castaneus*. Of Allolobophoras and the allies there were (5) *A. longa*, (6) *A. chlorotica*, with variety, (7) *A. turgida* and (8) *A. trapezoides*, which are two forms of *A. caliginosa*, (9) *Eisenia fœtida* and (10) *E. mucosa* (= *rosea*), (11) *Dendrobæna mammalis*, (12) *D. subrubicunda*, and (13) *D. octœdra* (see above, Peebles). Later gleanings added two further species, viz. (14) *Allurus tetrædrus*, and (15) *Octolasium lacteum*, while a further species could not be determined with certainty.

16. Roxburgh.—While Ross is still, so far as I am aware, without a single record, Johnston's 'Catalogue' alludes to (1) *L. anatomicus* and (2) *L.* (= *Eisenia*) *fœtidus* as having been found in Roxburgh.

17. Shetland Isles.—The Rev. W. G. Dixon sent me samples some years ago, but the list is mislaid. They were, however, all common types, and numbered about half a dozen species. There ought to be a dozen at least, and one or two would in all probability be of exceptional interest.

18. Stirlingshire.—In March, 1910, when Mr. Evans was very active in this department, he sent me from Falkirk about seventy specimens, which are referred to nine species as follows: Three species of *Lumbricus*, (1) *L. terrestris*, (2) *L. rubellus*, (3) *L. castaneus*, with (4) *A. longa*, (5) *A. caliginosa*, (6) *A. chlorotica*, (7) *D. subrubicunda*, (8) *D. mammalis*, (9) *Eisenia rosea*; and he adds (10) *Allurus tetrædrus*, Sav., and (11) *Eisenia fœtida*.

It will be seen that much remains to be done. The Highlands would well repay careful study, and the western coasts and islands would be certain to yield some good results if only a good collector would devote some little attention to their investigation.

Appended is a list of species so far known to occur in Scotland. Where necessary the synonym is also given :—

1. *Allurus* (= *Eiseniella*) *tetrædrus*, Sav.—Common.

2. *A.* (= *Eiseniella*) *hercynius*, Mich.—One specimen (from Fife) only found. Unknown elsewhere in Great Britain.

3. *Eisenia fœtida*, Sav.—Brandling. Common.

4. *E.* (*Dendrobæna*) *alpina*, Rosa.—Once found in Perthshire. The only British record.

5. *E. rosea*, Sav. (= *mucosa*, Eisen).—Common.

6. *Allolobophora caliginosa*, Sav.—Under two forms : (1) *A. turgida*, Eisen, and (2) *A. trapezoides*, Dugès.

7. *A. longa*, Ude.—Widely distributed.

8. *A.* (*Aporrectodea*) *chlorotica*, Sav.—Common.

9. *Dendrobæna subrubicunda*, Eisen.—The Gilt-tail.

10. *D. arborea*, Eisen. The Treeworm.—Not uncommon.

11. *D. mammalis*, Sav. (= *A. celtica*, Rosa).—Rather widely distributed.

12. *D. octædra*, Sav. (= *bœckii*, Eisen).—Only twice recorded for Scotland ; rare in England.

13. *Helodrilus oculatus*, Hoffmeister.—Near Edinburgh. Widely spread in England ; also found in Dublin and Jersey.

14. *Bimastus eiseni*, Levinsen.—Rather rare ; Edinburgh (Ravelrig) is the only record for Scotland.

15. *B. constrictus*, Rosa.—Fairly common.

16. *Octolasium cyaneum*, Sav. (= *A. studiosa*, Rosa).—Local. Reported for Fifeshire and Peebles.

17. *O. lacteum*, Oerley (= *A. profuga*, Rosa).—Received hitherto from Renfrew only for Scotland.

18. *O. gracile*, Oerley.—Quite a distinct species in England, though not so regarded on the Continent. So far known in Scotland only from Perthshire. (See 'Science Progress,' July, 1913.)

19. *Lumbricus rubellus*, Hoffmeister.—Generally distributed.

20. *L. castaneus*, Sav.—Usually plentiful.

21. *L. festivus*, Sav. (= *L. rubescens*, Friend).—Rare ; Isle of May and Renfrew (Paisley).

22. *L. terrestris*, Linn.—Common.

VARIATION (AS ILLUSTRATED BY A DOUBLE-HEADED WORM).

By H. Victor Jones,
Assistant Demonstrator in Zoology, Bangor University College, North Wales.

During the summer of 1912, while examining a number of earthworms of the species *Lumbricus*, which had been brought to the laboratory by Mr. J. A. Baxter, of Llanfairfechan, for the purpose of dissection, I was fortunate enough to come across a specimen of *Lumbricus* which showed marked Meristematic Variation, commonly known as a Double-headed Worm. A second worm was also discovered, showing incipient bifurcation. Both worms were sexually mature, and in very good condition when obtained.

A close observation was kept on the habits and instincts of these creatures, for the purpose of finding out whether they behaved differently from normal individuals of the same species. They were under observation for a period of eight weeks, during which time they were in a thriving condition. From the character of their Variation many interesting facts were obtained.

At the end of the series of experiments, under the control and supervision of Professor P. J. White, the worms were killed, and will at some future time be examined anatomically, as it will be interesting to follow the Variation in the internal structures of the alimentary and nervous systems respectively.

Before giving a very brief account, morphologically and physiologically, of these worms, it would be advisable to give here a summary of the *extent* of the knowledge and importance of Variation.

Bateson, in his 'Materials for the Study of Variation,' 1894, gives a very clear and concise explanation of the subject: "To solve the problem of the forms of living things is the aim of the present-day naturalists." He asks: "How have living things become what they are, and what are the forces which govern them?"

Darwin, no doubt, gave us the first hope of a solution in the production of his 'Origin of Species': "No character of Form is common to all things." On the contrary, Form is infinitely diverse.

The existence among living creatures of a specific difference is a characteristic of Life, and to these phenomena of the occurrence of differences between the structure, the instincts or other elements which constitute the individual, the term "Variation" has been given. The importance of Variation is clearly shown by the fact that it is upon these phenomena that all theories of Evolution are based.

It is unnecessary to enter into the theory of the 'Doctrine of Descent,' which states that all living beings are genetically linked, unless the alternative theory is held, namely, that separate creations were resorted to, which theory is now held to be absurd, but still, although the balance of evidence is in its favour, we must bear in mind that it is as yet to a great extent an assumption, and that it is adopted as a working postulate.

Lamarck, as will be remembered, regarded organisms as machines, which have the power of adaptation as an inherent quality in them. Therefore, as the world changes, so does the individual—that is, the universe and the individual change *pari passu*. This is Lamarck's explanation of the occurrence of Variation. Darwin, on the other hand, acknowledges the presence of Variation, but does not suggest emphatically any cause for its presence, because he found that some of the Variations were not adaptations, but quite the contrary.

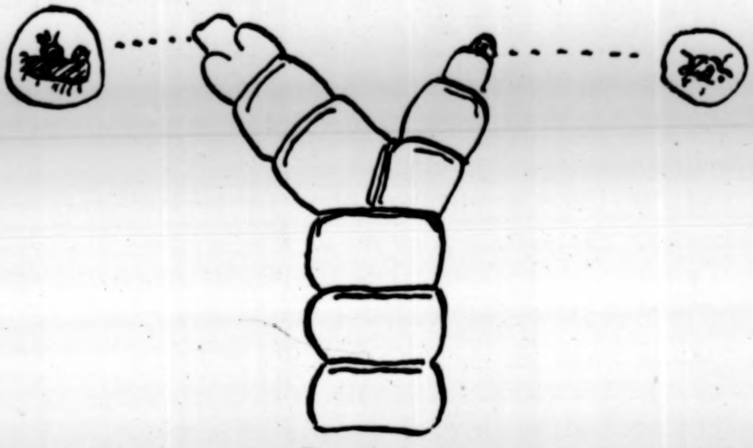
The readiest way, and one which is being universally adopted, of solving the problem of Variation is to study the facts of Variation. This is done in two ways:—

(1) Embryologically.

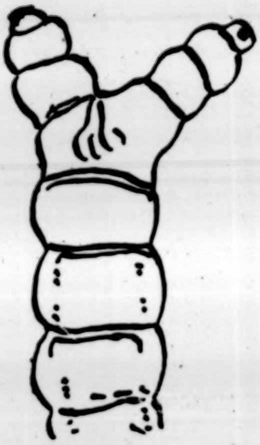
(2) By the study of adaptation as shown in the organism.

The first has as yet given little light upon the subject; the second much more.

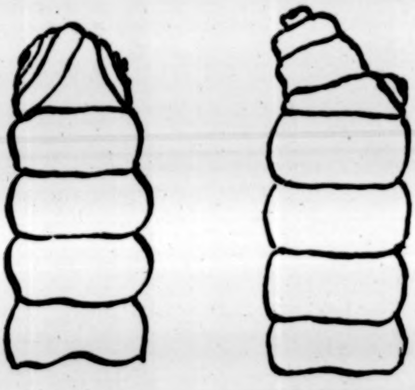
Getting now to the subject of Variation as exhibited by earthworms, so far as examination has gone, Bateson, in his valuable book, 'Materials for the Study of Variation,' states that double-tailed earthworms are plentiful, but that double-headed earthworms are of rare occurrence, only a very few specimens having been recorded up to 1904. Bifurcation of the head region to an extreme degree is shown by a specimen in the possession of Professor J. A. Thomson, of Aberdeen, who very kindly examined the present specimen.



Dorsal view.



Ventral view.

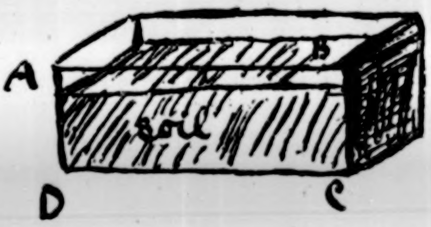


Contracted. Expanded.

Positions of heads while burrowing.

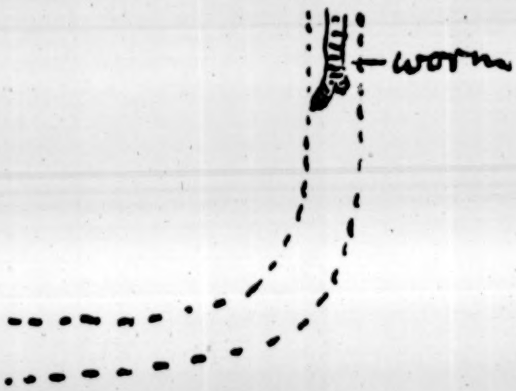
Description of Worm.—The worm, as already stated, was sexually mature, and about nine inches long. The bifurcation was very nearly symmetrical, one head having four complete segments, the other three (*vide* diagrams). Both heads showed the first segment or prostomium very clearly. Each of the two heads had a mouth—an open lumen—both of which were capable of taking in food.

Observations.—The worms were kept for observation in a box two feet square by one foot deep, one side of which, A, B, C, D, was of glass. This box was nearly filled with vegetable mould, sifted so as to be of fine texture, and fairly well dried, in order to facilitate penetration in burrowing by the worm.



The following, briefly, are the facts observed :—

(1) On being placed on the surface of the soil near the glass side, and a cloth placed over the glass, it was seen, by the removal of the cloth from time to time, that the worm burrowed by keeping the lesser head in a retracted condition, and alternately expanding and retracting the larger head, thus penetrating the soil after the manner of the normal individual of the same species. The path, however, always took the form of a curve in the direction of the larger head, owing, no doubt, to the slightly increased irritation of the smaller head causing a deflection in the opposite direction, being an attempt to lessen the irritation. This seemed decidedly the case, for whenever the smaller head came against the smooth glass (therefore, no appreciable friction and irritation) the path took the normal irregular direction.



Path of Burrow.

(2) When the glass side was uncovered, the burrowing ceased and was not resumed until darkness again prevailed. The head part was much more sensitive to light than the hinder end.

(3) Sounds seemed to affect the worm to *no* appreciable extent.

(4) The sense of touch was developed to an extreme degree, the slightest contact with the glass causing the worm to stop work and contract, a sure sign that it appreciated the proximity of danger.

(5) However, when the provocation proved of a natural order, such, for instance, as a glass rod inserted into the soil in imitation of a burrowing mole, the worm would penetrate the soil quickly, making its way to the surface and not deeper into the soil. This seems to point to the fact that worms can discriminate between disturbances of the soil caused by various means, and also that they instinctively seek the surface, knowing that a mole would avoid the light as much as possible.

(6) When it was placed on a fairly smooth surface it invariably moved in *a circle*, the larger head always being towards the centre of the circle.

(7) In its progress, the larger head expands and contracts in point of time slightly in advance of the smaller, showing that the greater degree of sensitiveness is placed in the larger head.

(8) Again, when the progress of the worm was barred by placing a pin vertically at the forking of the heads, it was invariably found that the worm passed the pin by allowing the *larger* and not the lesser head to slide past the obstruction, which confirms the surmise that greater sensitiveness is possessed by the larger head.

The above are some of the observations briefly stated.

Before bringing this paper to a close, it might be stated that concerning the embryological study of Variation we have the results of Roux and others concerning the segmentation of the metazoon ovum, showing that in certain species the first cleavage plane divides the body into the future right and left halves of the adult animal.*

This suggestion, which is an old one, received support from the fact of Meristematic Variation, especially the formation of homologous twins and double-headed monsters, which are shown to arise from one ovum by division. (*Vide* Driesch, Zt. f. w. Zool. 1891, liii. p. 160.)

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* It is the second cleavage in many cases. (*Vide* E. B. Wilson, Anat. Anz. vii. 1892, p. 732.)

Now, this theory is difficult of explanation in regard to the appearance of double-headed worms, unless we take the possibility that the potentiality of a *Double Individual* in the ovum, for some inexplicable reason, has been delayed until the time of the formation of the head region, thus giving only an approach to the possible double individual which was prophesied of in the original ovum.

On the other hand, division of the meristematic cell may explain the problem, and this, as yet, is by far the most likely. Still the question remains an open one.

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NOTES AND QUERIES.

MAMMALIA.

Black Rabbits.—Black Rabbits have, in my experience, always been rare in this neighbourhood, and until last autumn I had not seen one for a number of years. Then, curiously enough, I shot two. The first was at Bloxham, on Oct. 25th—coal-black all over. The other I got at South Newington Hill, about three miles off, on Nov. 28th. It was of a beautifully shining black, with a few white hairs scattered over it, rather like "silver-fox" fur, and had a small white spot about the size of an average sweet-pea seed on the under side of the tail. There are a great many Rabbits at the latter place, and during the last few years I have shot and seen a considerable number, but I never before saw a "variety" of any kind there. I do not think domestic Rabbits have ever been turned out there (or at Bloxham); the difficulty has been to keep the Rabbits down, although Badgers live in the same hillside (and Foxes in the gorse below), and are commonly believed to dig out the "stops" when the Rabbits are breeding. In some parts of the country Black Rabbits are, I know, not at all uncommon.—O. V. Aplin (Bloxham, Oxon).

Decrease of the Squirrel.—I should be glad to know if the Squirrel has decreased in England generally. In this neighbourhood, in my younger days, it was quite common (although there are no large woods about here), inhabiting even small spinneys and plantation belts, and being met with often in rows of trees away from them out of the breeding season. They were in the habit of visiting orchards and walled-in gardens in villages, where they used to steal the plums and other wall-fruit. But for a good many years they have been getting gradually scarcer, and I do not remember having seen one in this parish for several years. Bloxham Grove was formerly a great place for Squirrels, which used to breed in the big trees in front of the house, and were a familiar sight running over the turf from tree to tree. It was here, I think, that I first saw what have been described as "white-tailed" Squirrels. They have all been gone for years, and the owner told me a few days ago that one he saw on his property about a year ago is the only Squirrel he has met with for a long time. At Wroxton, too—where there are some woods—I am told they have very few Squirrels now.—O. V. Aplin (Bloxham, Oxon).

AVES.

White Wagtails in Co. Mayo.—On their spring migration this season *Motacilla alba* has paid its usual visit to the island of Bartragh, Killala Bay. On April 24th four birds were observed on their usual haunt, a wet sandy flat growing a short coarse grass, extending from the shore of the estuary to the sandhills, and situated close to the stackyard and garden. On the 28th another small party were noticed at the same place, out of which Captain Kirkwood kindly obtained three specimens for me to send to friends. Now, with the exception of one season, they have regularly visited Bartragh every season since *1897*, proving without any doubt that the *Motacilla alba* have a regular line of flight, passing over the island of Bartragh on their way to their northern breeding grounds. It is strange that being so regular in visiting the island on their spring migration only *once* was a solitary bird observed in autumn.—Robert Warren (Ardnaree, Monkstown, Co. Cork).

Willow-Titmouse in Norfolk.—The Willow-Tit, which was identified at Beccles by Mr. C. B. Ticehurst last August, was erroneously entered in the "Report for Norfolk" (*ante*, p. 175) as having belonged to the northern race, instead of being recorded as a British Willow-Titmouse (*Parus atricapillus kleinschmidti*, Hallmayr); see 'Hand-list of British Birds,' p. 46.—J. H. Gurney (Keswick, Norwich).

A Bornean Example of Butreron capelli, Temm., with Double Hallux.—According to Bateson, in his 'Materials for the Study of Variation,' 1894, p. 390, the records of polydactylism in birds are few and far between; perhaps therefore the following case may be worth placing on record:—A wild female Large Thick-billed Green Pigeon (*Butreron capelli*, Temm.)—a species confined to Malaya—was shot recently near Bau, Sarawak, by Mr. R. B. Williams, and presented by him to the Sarawak Museum. In both feet the hallux is duplicated from the tarso-metatarsus, the additional hallux, perfectly formed with separate metatarsal, arising between the ordinary hallux and the second digit, and with a web loosely connecting the proximal phalanges of the double hallux, but not thus connected to the second digit. The ordinary hallux is similar in size and development to that of an undeformed specimen, and the additional hallux is the same, or if anything very slightly larger. The specimen is now in the Sarawak Museum.—J. C. Moulton, Curator of the Sarawak Museum (Sarawak).

Dark Variety of the Red-legged Partridge. — Three very dark-coloured Red-legged Partridges were shot by some friends of mine in the autumn of 1912 when "driving" between Hook Norton and Sibford, in this county—two of them on Nov. 18th and the other on Dec. 28th. They were all believed to have belonged to the same covey, but whether there were any more in it of the same colour is not known. They were so dark in general appearance that some of the guns spoke of them as "black." One of the birds killed in November was given to me, and I have had the skin preserved. It was a fine well-grown young male, fully moulted, and weighed 18½ oz. The whole plumage has a dark smoky cast over it. The upper parts show distinct blackish edges to the feathers. Throat smoky grey instead of white. Breast a fine dark slaty blue. Middle of the belly smoky brown instead of chestnut, becoming still more dusky towards the lower tail coverts. Thighs blackish brown instead of chestnut. The legs and beak were of a rich, deep blood-red.—O. V. Aplin (Bloxham, Oxon).

Squacco Heron (Ardea ralloides) in Co. Cork.—A specimen of this rare visitor to Ireland was shot on May 13th by Mr. Beecher near one of the small loughs adjacent to Skibbereen; it is a female in the breeding plumage. The first specimen of this rare Heron captured in Ireland was shot, in Killeagh Bog, near Youghal, the beginning of April, 1849, and, falling into the hands of Mr. Samuel Moss (after being mounted), was sent for identification to his friend Dr. Harvey, of Cork, with whom I saw the specimen a few days afterwards. I believe that from the date of this first capture only seven or eight specimens have been obtained in Ireland.—Robert Warren (Ardnaree, Monkstown, Co. Cork).

Crane in Oxfordshire.—An adult Crane was shot near Adderbury on March 10th, 1913, and seen in the flesh by me. It is quite probable that it was an escaped bird, although the plumage showed no signs of this; the bird was, however, rather fat. I should be glad to hear if anyone lost a Crane about that time. This individual may be recognized by the following peculiarities, *viz.* the bill was slightly bent to one side near the tip, and the inner primary of one wing was white. I was only able to make rough measurements, and these were as follows: bill a bare four inches in length; tarsus, 8 in.; wing, 21 in.; total length to the end of the tail, 42 in.—O. V. Aplin (Bloxham, Oxon).

INSECTA.

Surrey Odonata.—While angling in the Mole near Horley, on June 16th, I was frequently visited by two females of the beautiful Dragonfly, *Calopteryx virgo*. The only other record I know of the species on the Mole is given in Lucas's 'British Dragonflies,' *viz.*: "River Mole, near Leatherhead (W. J. Ashdown)." Last year I found this insect literally swarming in South-west Cornwall, where it is a common species. On Aug. 17th, 1912, I was very surprised to find a fine specimen of *Æschna grandis* trying to enter my greenhouse at Norwood. He became a permanent lodger as a cabinet specimen.—W. L. Distant.

OBITUARY.

Sir Jonathan Hutchinson, F.R.S., LL.D.

The medical and surgical work of the late Sir Jonathan Hutchinson has received its great and deserved tribute in the columns of every daily paper, and in many other periodicals. A short notice on Sir Jonathan's interest in Natural History will not be out of place in 'The Zoologist.'

There is a story that the late King Edward, at the mention of Jonathan Hutchinson's name, many years ago, exclaimed: "Ah, yes, he's the man who keeps a farm for diseased animals." This was hardly the whole truth and nothing but the truth, but there was this much truth in it—that every ailment amongst his animals was of the utmost interest to Sir Jonathan, and that most of them were treated by himself. And it would almost be fair to say that he would have been rather disappointed had his farm supplied him with no interesting patients. To learn something from everything, great or small, and to impart his knowledge (in no pedantic manner, be it said) were the two great joys of his life. His only recreation (apart from change of work, which he considered sufficient) was shooting. He liked to wander round his farm with a gun, and occasionally to have a shooting party. Big bags were an abomination to him, and an impossibility on the lines on which those shooting parties were carried out. Halfway across a turnip field some such object as an arrow-head, or a fungus on the leaves, would catch his eye, and those nearest to him would be treated to a discourse, or asked for information on the subject. The whole line would be kept waiting, but those at a distance were the only ones who were bored by the interruption. If a bird or a rabbit exhibited unusual signs when shot, it had to be kept apart and examined *post mortem*, to see what portion of brain or other part was affected. On one occasion a rabbit which fell dead in a somewhat curious way was found to have no shot wound in it anywhere, and was diagnosed as having died of "heart failure." The shooting was a means to an end with Sir Jonathan, not the only end in view for the day, as with most sportsmen.

The Haslemere Museum began in quite a small way in the old barns at Inval, Sir Jonathan's home, and there he was delighted to see his friends and the members of the Natural History Society on Sundays, and to discourse to them on a great variety of subjects. In 1896 the present Museum was built, and the home collections transferred there. A curator was engaged, and with his usual intuition Sir Jonathan found in Mr. E. W. Swanton exactly the man he wanted. Under Mr. Swanton's care the Museum has grown and prospered wonderfully, and from attendances of three or four hundred per annum the numbers have run into seven and eight thousand. Sir Jonathan was an inveterate frequenter of Stevens's Sale Rooms, whence came many of the exhibits in his Museums both at Haslemere and Selby. Rarities did not interest him to any extent unless there was something special to learn from them. He did not worry about having a complete collection of local insects, animals, or plants. If they came along, well and good, and many a splendid donation of this kind has been made to the Haslemere collections. But something to learn from, and to teach from, was considered of far more importance than some unique specimen or first record. It will be of interest to quote from the programme of Sunday lectures two of the lists of subjects on which Sir Jonathan would address his hearers at a single sitting (or more probably *standing*, for they would be led from one department to another as the subject changed):—"Sunday, June 7th. The Thickness of the Earth's Crust. The Moa and the Æpiornis. Elephants. John Wesley. July 19th. The Earliest Traces of Man. Indian Corn. Seaside Objects. Cowper and his Poetry." Curious mixtures, one thinks! But this was the idea:— "To travel with his audience for a short distance along four of the great pathways of knowledge; for instance, (1) Geology, as representing the inorganic earth which we inhabit; (2) organic life, such as Botany or Anatomy; (3) to turn over a leaf of the great book of human history; (4) to focus the attention upon the special study of some one great man who stood out from among his fellows." No one was ever, or could be, bored at these lectures. The most unlikely people found themselves gaining an interest in some subject that had never appealed to them before. One of his sons' schoolfellows, a boy keen on athletics and sport mainly in those days, said many years after that it was to the breakfast-table talks of his host, during the holidays, that he owed his present love of both natural history and poetry. How Sir Jonathan, with his great surgical and consulting practice, found time to study such a multitude of other subjects, and to learn by heart much of our best poetry, will always be a marvel to those who knew him. But he never said in his life that he "hadn't time," until the closing months, when he would sometimes sigh that there was so much still to do, so little time and strength to do it.

L. H.

NOTICES OF NEW BOOKS.

"*J.*" *A Memoir of John Willis Clark, Registrary of the University of Cambridge and sometime Fellow of Trinity College.* By A. E. Shipley, Master of Christ's College. Smith, Elder & Co.

This is a delightful book to read; it describes a unique personality, a hard-working official, and an enthusiastic lover of his University; he was, moreover, a zoologist in taste, zeal, and museum activity. The fact that he was known as "J." denotes his popularity, though he was not apparently always all smiles, nor did he seem to "suffer fools gladly"; but the book describes a real man, and one more loved for being very human, as well as staunch and sincere. His father issued, at the age of sixty-eight, his translation of Van der Hoeven's 'Handbook of Zoology,' and as translator had to learn Dutch before he could put it into English; as Dr. Shipley remarks: "a remarkable performance for a man nearing seventy."

This publication is quite outside the usual biographical horror, in which its subject is always a hero and dressed in his best meeting-house clothes. John Willis Clark is never more and never less than the beloved "J.," erudite, critical, and laborious, while the pages in which he is described are reminiscent of old customs in old University days. Dr. Shipley has also spared no pains in the identification of many who appeared in the same orbit as the subject of his memoir, and in this way much social and local history will be found by writers of books, while there are some really good stories. One must be reproduced; it relates to a Don who, married late in life, "returning to his church after a honeymoon of six weeks, publicly thanked God for *three* weeks of unalloyed connubial bliss."

Zoologists will find their prey in Appendix I. "J. as Superintendent of the Museum of Zoology," for it is a life-history of that institution, being a full record of the many able men who have taught there and arranged the collections, and a record of all the principal acquisitions and their donors. There is great value to naturalists in this information.

BRITISH 5 AUG 13 MUSEUM